

ABSTRACT

Systems for highly efficient, *in-vivo* collection of modulated infra-red light are presented. Specifically, these devices are arranged in an important format with a view to integration with a wristwatch or other wearable device. An optical aperture of large
5 surface area, specially distributed in an annular ring, receives radiation having been modulated in a tissue test site by blood flow. Radiation received about the annular aperture is redirected by a blazed grating or similar optical element at near perpendicular angles, into a radially distributed, condensing light pipe array and further toward a common axis. Radiation converges on the axis, thus increasing the energy density of the
10 collected signal, before it is further directed via a conic element to a detector such as a photodiode. In some versions, these highly specialized optical paths may be formed into a single element of inexpensive plastic or other rigid substrate.